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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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10/649,099

08/26/2003

Woody K. Sattayapiwat Tang

M-12977 US

4957

32605

7590

11/30/2006

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EXAMINER

DAHIMENE, MAHMOUD

ART UNIT

PAPER NUMBER

1765

DATE MAILED: 11/30/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

## Office Action Summary

Application No.

10/649,099

Applicant(s)

TANG ET AL.

Examiner

Mahmoud Dahimene

Art Unit

1765

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☐ Responsive to communication(s) filed on 20 October 2006.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 3-23,27-35,37,38 and 40 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☒ Claim(s) 3-23,27-35 and 37 is/are allowed.
- 6) ☒ Claim(s) 38 is/are rejected.
- 7) ☒ Claim(s) 40 is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

### Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
  - ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

### Attachment(s)

- ☒ Notice of References Cited (PTO-892)
- ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- ☐ Information Disclosure Statement(s) (PTO/SB/08)  
Paper No(s)/Mail Date \_\_\_\_\_
- ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date \_\_\_\_\_
- ☐ Notice of Informal Patent Application
- ☐ Other: \_\_\_\_\_

***Request for RCE Acknowledged***

A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 10/20/2006 has been entered.

***Allowable Subject Matter Withdrawn***

The indicated allowability of claim 39 in the previous office action filed on 05/18/2006 is withdrawn in view of the newly discovered reference(s) to Wolf et al. (Silicon Processing for the VLSI Era, Volume 1- Process Technology, Lattice Press, 1986). Rejection of the amended claim 38 (which now includes the limitation of claim 39 (claim 39 has been canceled)) based on the newly cited reference(s) follow.

**DETAILED ACTION**

***Claim Rejections - 35 USC § 103***

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Art Unit: 1765

2. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

3. Claim 38 is rejected under 35 U.S.C. 103(a) as being unpatentable over Chen et al. (US 5,661,083) in view of S. Wolf and R.N. Tauber, (Silicon Processing for the VLSI Era, Volume 1- Process Technology, Lattice Press, 1986).

Regarding claim 38, the reference of Chen describes a method for via formation with reduced contact resistance wherein a structure, shown (figure 2B) to have a photoresist layer (210) on top an oxide layer (208)(which reads on applicant's limitation of an oxide based layer positioned on top (with an interface) of an ARC layer (206). Chen teaches "also formed during the oxide etching process is a coating of polymeric debris which is deposited on the floor of the via" (column 4, line 18). For example, where carbon tetrafluoride ( $\text{CF}_4$ ) is used as the processing gas,  $\text{SiO}_2$  is used as the oxide layer and (TiW) or (TiN) is used as the ARC, the polymeric debris formed in the via comprises polytetrafluoroethylene ( $\text{C}_2\text{F}_{2+n}$ ) in addition to atoms of oxygen, silicon, titanium, and aluminum (column 1, lines 50-58). Clearly Chen teaches residues will contain materials from layers that have been etched or contacted

Art Unit: 1765

by the etching plasma in addition to byproducts of the gases used in the plasma for etching the layers. Chen further discloses A portion of the oxide layer is then removed to expose the underlying etch stop layer (ARC). A portion of the etch stop layer is then removed using a reactive ion etch-downstream microwave ash system (column 2, line 32), the reactive ion etch is performed under a nitrogen/hydrogen (N.sub.2 /H.sub.2) atmosphere. In a more specific embodiment, the atmosphere further includes carbon tetrafluoride (CF.sub.4) (which reads on applicant's limitation of a first agent which will react with the TiN ARC layer to produce volatile byproduct (column 2, line 45).

It is noted that Chen is silent about the formation of residue having a base portion, however, it would appear that the oxide etch process of Chen would inherently result in exposure of residues having a base portion because Chen discloses the same structure as the one claimed by the applicant of an oxide layer overlying a metal containing ARC layer and wherein the oxide has been patterned to expose the arc layer. The method of Chen removes those residues by exposure to the N<sub>2</sub>/H<sub>2</sub>/CF<sub>4</sub> plasma, this chemistry certainly reacts with a first metal element of the metal containing ARC layer (Ti) to produce volatile products.

In addition, applicant's claimed formation of residues with base portion reacting with the chemically reactive agent would obviously be produced upon practicing the process of Chen et al. (US 5,661,083).

Chen discloses TiN or TiW for the ARC layer, and Ti is in the residue (column 1, lines 50-58).

It is noted that Chen is silent about argon particles in the residue removal plasma.

Wolf illustrates the etch (removal) rate enhancement effect of argon ions when used in combination with a chemical agent such as fluorine (figure 11, page 552).

Therefor, it would have been obvious to one of ordinary skill in the art at the time the invention was made to improve the residue removal rate of the method of Chen by adding argon to the residue removing plasma because Wolf teaches removal rate of a plasma is substantially enhanced by adding argon ion bombardment. One of ordinary skill in the art would have been motivated to add argon to the residue removal plasma of Chen in order to increase the removal rate.

***Allowable Subject Matter***

4. Claims 3-18, 27-35, 37, are allowed.
5. The following is an examiner's statement of reasons for allowance:

Regarding claims 3 and 35, the closest prior art of record of Chen et al. (US 5,661,083) does not disclose or suggest employing HCl, Cl<sub>2</sub>, BCl<sub>3</sub> or chlorine molecules as a chemically reactive agent in a plasma for reducing micromasking residues remaining within an exposed interface of an oxide-based hardmask and metal containing ARC layer, and with the rest of the limitations of claims 1 or 35.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably

Art Unit: 1765

accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

6. Claim 40 is objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Regarding claim 40, the closest prior art of record of Chen et al. (US 5,661,083) does not disclose or suggest employing a plasma for removing residues using a chlorine-based dry etch of a metal-containing anti-reflection coating layer (ARC layer) that directly underlies the hardmask, and with the rest of the limitations of claim 38.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Mahmoud Dahimene whose telephone number is (571) 272-2410. The examiner can normally be reached on week days from 8:00 AM. to 5:00 PM..

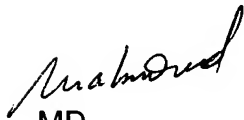
If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nadine Norton can be reached on (571) 272-1465. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300. Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For

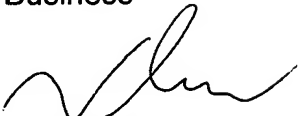
Application/Control Number: 10/649,099

Page 7

Art Unit: 1765

more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

  
MD.

  
LAN VINH  
PRIMARY EXAMINER